KANSAS RISK-BASED CORRECTIVE ACTION

FOR PETROLEUM STORAGE TANKS SITES

REPORT FORMAT

July, 2003

Kansas Department of Health and Environment

Bureau of Environmental Remediation

Storage Tank Section

TABLE OF CONTENTS

SECTION 1.0 FIELD WORK PLAN SUBMITTALS

1.1 Submit two copies of the Field Work Plan Worksheet, maps and Site Conceptual Exposure Model. The Field Work Plan Worksheet is included in Attachment A. The Field Work Plan shall contain all requested information. Additional information should be included as needed.

SECTION 2.0 KRBCA REPORTS

2.1 KRBCA Reports will be a summary of all work performed and gathered during activities conducted under the KRBCA phase and previous assessments.

2.2 Report will be bound and include a cover page with the following information: report title; site name; site address; KDHE project code; KDHE facility I.D. number; section, township, and range to four quarters; report date, and the name of the person who prepared the report. Cover page must be stamped and signed by a Kansas Licensed Geologist or Licensed Professional.

2.3 Reports will include a table of contents with the following information:

1) section titles
2) titles and page numbers for tables
3) titles for figures
4) titles for each appendix

2.4 Reports will include labeled tabs for each section title and each appendix.

2.5 Two copies of each Final Report will be submitted to the KDHE Project Manager within 120 days after the date of the letter approving costs for additional scopes of work or after the contract between the O/O and Vendor has been signed by all parties. One copy will be submitted to the respective O/O.

Incomplete or improperly formatted reports will be returned without review. For reports returned without review the submittal deadline will not be considered to have been met until a complete report demonstrating that the investigation goals have been met is received by KDHE.

The vendor may wait until the report has been reviewed and approved by KDHE before providing the O/O with a copy. If the Vendor provides the O/O with a copy prior to approval of the report, copies of any and all revisions and/or addenda must also be provided to the O/O. Specific sections of the Final Report will also be submitted in electronic form on a Compact Disc (CD).

2.6 All work will be performed in accordance with the LSA RFP, version 9, March 2003* and the Kansas Risk-Based Corrective Action (KRBCA) Manual, version 4, July 2003. Both documents are available upon request or at www.kdhe.state.ks.us/tanks.

* KRBCA reports will be submitted according to the KRBCA Report Format, version 3, July 2003 and not according to Section 4.5, Final Report, Assessment Phase, of the LSA RFP.

SECTION 3.0 TIERED REPORTS

3.1 Tier 2 Reports

See Section 4.0, Final Report Format, on how to note figures, tables and appendices not applicable to the site.

At a minimum, the following portions of Section 4.0, Final Report Format, will be included in Tier 2 Reports.

Section 1.0 Site Summary
- 1.1) Site History

Section 2.0 Tables
1) Table 2.1, Summary of Work Completed
2) Table 2.3, Soil Field Screening and Laboratory Results
3) Table 2.4, Groundwater Analytical Results
4) Table 2.5, Monitoring Well Completion Information
5) Table 2.6, Waste Handling Results
6) Table 2.7, Unsaturated Zone Hydrologic Tests and Properties
7) Table 2.8, Saturated Zone Hydrologic Data

Section 4.0 Maps
1) Figure 1, General Site Location
2) Figure 2, Area Base Map (Figure 2.2 not required)
3) Figure 3, Groundwater Flow Map

Section 5.0 Drilling Logs

Section 7.0 Documentation
3) Appendix 3, Unsaturated Zone Hydrologic Data
4) Appendix 5, Laboratory Data
5) Appendix 6, Field Notes
6) Appendix 7, Reports, Access Agreements, Lien Releases and Monitoring Well Information

7) Appendix 8, Off-Site Waste Handling Documentation
8) Electronic Data

3.2 Tier 3A Reports
Include all sections of Section 4.0, Final Report Format, except the following:

Section 3.0 Table 3.4 Tier 3B Analysis

3.3 Tier 3B Reports
Include all sections of Section 4.0, Final Report Format.

SECTION 4.0 FINAL REPORT FORMAT

Reports will include all information outlined below in the format and order described. Figures, tables and appendices not applicable to the site should be so noted in the Table of Contents. Do not change the item numbers designated below. Items within tables that may not be applicable, such as free product thickness, should be stated in the table to be not applicable.

Section 1.0 Site Summary

The site summary section will include the following information.

1.1 Site History: Include a detailed and chronological summary of all past and recent work performed at the site.

1.2 Regional Geology: Review local and regional geologic and/or hydrogeologic maps, nearby site assessments and/or investigation reports and any other pertinent publications. Identify any aquifers and/or surface water bodies serving as sources of drinking water for the area. Identify and evaluate the use and/or potential use of the uppermost groundwater zone within 0.25 miles of the source of the release at the facility.

1.3 Land Use: Investigate and describe past, current, and potential future uses of the site. Identify potential source areas, migration pathways, and receptors. Indicate and describe all subsurface structures that are potential or current receptors of contaminated media. Determine past and current uses of adjacent properties to identify other potential sources of chemicals of concern (COC). If an off-site receptor is identified, assess the past, current and potential future land use. Future land use assumptions should be based on current use, existing zoning, and development trends of adjacent properties. Document any ordinances preventing or influencing the future installation of water wells at the site or in the surrounding area such as groundwater protection areas. Identify the current predominant land use of the area as residential, commercial, recreational, agricultural, or undeveloped.

Identify sensitive receptors, such as surface water bodies, wildlife sanctuaries, and wetlands.

1.4 Source History: Locate current and/or former tank systems and other potential sources such as spills or overfill incidents, both on and off-site. Investigate and summarize any previous assessment work, such as tank removal data, previous site assessments, release investigations and/or remediation activities that may have been conducted on-site and on adjacent properties. List all previous business names of the facility and whether fuel was dispensed at the facility by previous owners. List all current and previous owners of the facility with current address(es).

1.5 Conclusion: Summarize findings of the KRBCA investigation. Reference data which necessitated Tier 3A and/or 3B evaluations. Include recommendation for closure, continued monitoring or corrective action and substantiate based on the findings included in the report.

Section 2.0 Field Work Tables

Tables must be labeled with the numbers and titles provided below. Number each page of tables. Include in the table a column or row for each numbered item requested. Do not reference or include in this section, any discussion, tables, maps, photographs, drilling logs, or other documents included in this report. Abbreviations or material referenced from other publications should be explained at the bottom of the table.

Table 2.1 Summary of Work Completed

Include the following information for work completed during the KRBCA scope of work:

1) total number of plugged borings,
2) total number of monitoring wells completed,
3) total number of groundwater survey probes conducted,
4) total footage drilled,
5) total monitoring well footage,
6) total boring footage plugged,
7) total number of groundwater samples analyzed by laboratory,
8) total number of soil samples analyzed by laboratory,
9) total number of product samples analyzed by laboratory, and.
10) total number of waste water samples analyzed by laboratory.

Samples collected for saturated and unsaturated zone tests, properties and data included in Tables 2.7 and 2.8 should not be included in the total number of soil samples analyzed by laboratory.

Table 2.2 Water Well Information

Include the following information for all wells located within a 1/4 mile radius of the site.

1) the well owner's name,
2) the Section, Township and Range of the well location to three quarters, or to four quarters for wells sampled or located during the investigation, or used as a public water supply,
3) the use; select the use from those found in Section 4 of the WWC-5 form that best describes the use of the well,
4) the distance between the well and contaminant plume; give an approximate distance if the well location is known to only three quarters, and
5) the location of the well relative to the contaminant plume and groundwater flow direction.

The search for this information must include at least the following: 1) a water well records search conducted through the KDHE Bureau of Water (BOW), 2) a discussion with city and/or county personnel concerning the location of public and private water supplies for the area, and 3) a ground or house-to-house reconnaissance of the area within the contaminant plume(s) and a 500 foot radius surrounding the source of contamination. PWS wells should be designated with the same numbers assigned by the city, water district, or other well owner.

Table 2.3 Soil Field Screening and Laboratory Results

Include the following results for each field sample, including those not submitted for laboratory analysis, and each laboratory sample collected from a boring. Include the same information for past soil analytical data if used to determine representative concentrations for Tier 3A and/or Tier 3B analysis.

1) boring and/or monitoring well ID number assigned by consultant
2) the depth at which each sample was collected,
3) the field screening results in parts per million (ppm),
4) the concentration of each specified constituent in parts per million (ppm) determined by laboratory analysis; state the petroleum product(s) identified,
5) the date each sample was collected,
6) the EPA test method and laboratory analytical sample detection limit for each analyte in each laboratory sample, and
7) the instrument used for each field sample.
8) The Tier 2 Risk-Based Screening Level for each chemical of concern for both soil and soil to groundwater pathway for both residential and non residential scenarios.

Table 2.4 Groundwater Analytical Results

Present in chronological order all past and current results for each sample point. Include the following information for each groundwater and petroleum product laboratory sample:

1) well ID number
2) the concentration for each chemical of concern, in parts per billion (ppb),
3) the product(s) identified, or approximate % of each product if a mixture, for any product sample(s),
4) the volume, in gallons, of water removed from each well during well development,
5) the volume, in gallons, of water purged from the well prior to sampling,
6) the date the well was purged,
7) the date each sample was collected, and
8) the EPA test method and analytical sample detection limit for each analyte in each sample.
9) 25% of maximum value used to calculate representative concentration for each chemical of concern.
10) two year representative concentration for each chemical of concern for each well.
11) the Tier 2 Risk-Based Screening Level for each chemical of concern for both residential and non residential scenarios.

Highlight concentrations used to calculate representative concentration for each well. Bold representative concentrations that exceed tier 2 risk-based screening levels.

Table 2.5 Monitoring Well Completion Information

Include the following information for each well installed or sampled:

1) boring ID number assigned by the consultant,
2) well ID number assigned by the consultant,
3) well ID number from KDHE numbered well lock
4) the identification number from the KDHE well tagging Site I.D. form,
5) the location of the well tag,
6) the surveyed elevation of the well's vertical datum control point (survey pin or permanent mark on flush mount rim)
7) the surveyed elevation of the well casing,
8) the depth, in feet, to groundwater,
9) static groundwater elevation prior to purging (or development if wells are sampled the same day as development and the wells are not purged),
10) static groundwater elevation prior to sampling,
11) the elevation of the air/product interface,
12) the thickness of the separate-phase product, and
13) the date static water level was measured.

Groundwater levels must be measured under static conditions on the same day. If free-phase petroleum product is detected, groundwater elevations must be corrected using the specific gravity determined during the product sample analysis. Explain at the bottom of the table how the measurements were corrected.

Table 2.6 Waste Handling Results

Include the following information for wastes handled:

1) the type of waste (soil or water) generated,
2) the quantity of waste generated for each type of waste,
3) the storage and disposal methods used for each type of waste,
4) results of any field analysis of wastes conducted during on-site treatment,
5) results of any laboratory analysis of wastes,
6) specific location where wastes were disposed or discharged

Table 2.7 Unsaturated Zone Hydrologic Tests and Properties

For tables 2.6 and 2.7, identify source(s) of information for values included in the tables that were not calculated or acquired during this scope of work.

Include the following information.

1) boring ID number
2) the depth at which each sample was taken
3) the analysis method name and number
4) the sample collection method
5) hydraulic conductivity (cm/sec)
6) estimated porosity (cm^3/cm^3)
7) gravimetric water content (gm/gm) (Using ASTM Method D2216-98)
8) volumetric water content (cm^3/cm^3) (Using ASTM Method D2216-98)
9) dry bulk density (gm/cm^3) (Using ASTM Method D2937-00e1)
10) organic matter (%Organic Matter) (If ASTM Method D2974-00 is used)
11) total organic carbon (%Organic Carbon) (Walkley-Black Method/ASTM Method D2974-00)
12) lithologic description

Table 2.8 Saturated Zone Hydrologic Data

Include the following information.

1) monitoring well ID number
2) test or analysis method name and number (ASTM, EPA)
3) hydraulic conductivity value in centimeters per second (cm/sec)
4) the transmissivity value in $meters^2$/day
5) the storativity value
6) hydraulic gradient (ft/ft)

Section 3.0 Tier 3A and 3B KRBCA Tables

Tables must be labeled with the numbers and titles provided below. Number each page of tables. Include a column or row for each numbered item requested. Do not reference or include in this section, any discussion, tables, maps, photographs, drilling logs, or other documents included in this report. Abbreviations or material referenced from other publications should be explained at the bottom of the table. Contaminant concentrations and risk-based screening levels are to be in units of mg/kg (ppm) for soils and *ug*/L (ppb) for groundwater.

For Tables 3.1 and 3.2

1) No distinction is made between surficial and subsurface soil for construction workers. Soils from 0 - 10 feet will be evaluated as "Surficial Soils" for construction workers for Tiers 3A and 3B. See Section 3.5, Exposure Routes, in the KRBCA manual.

2) Groundwater resource protection pathway is always complete. Soil source and compliance well target levels are calculated independent of receptor.

3) Attachment D or similar format will be used.

For Tables 3.3 and 3.4

1) Include a reference table following the main table which includes boring ID and/or well number, sample depth, COC's and concentrations used to calculate representative concentrations.

2) For pathways that are not complete include a table or page indicating the pathway is not complete.

3) Attachment E or similar format will be used for Tables 3.3 and 3.4 A - F and the reference tables.

4) Attachment F or similar format will be used for Tables 3.3 and 3.4 G and the reference tables.

5) Reference Tables for Tables 3.3 and 3.4 A - D will be placed after Table 3.3 and/or 3.4 D. Reference Tables for Tables 3.3 and 3.4 E will be placed after Table 3.3 and/or 3.4 E. Reference Tables for Tables 3.3 and 3.4 F will be placed after Table 3.3 and/or 3.4 F. Reference Tables for Tables 3.3 and 3.4 G will be placed after Table 3.3 and/or 3.4 G.

Table 3.1 Site Conceptual Exposure Model - Current Conditions
Table 3.2 Site Conceptual Exposure Model - Future Conditions

For each of the following routes of exposure and receptors indicate if the exposure pathway is complete or incomplete for onsite and offsite conditions on both tables. Provide justification.

Surficial Soil for Resident Child, Resident Adult, Commercial and Construction Workers.

1) Outdoor Inhalation of Vapors and Particulates, Dermal Contact and Accidental Ingestion
2) Outdoor Inhalation of Vapors and Particulates
3) Ingestion of Soil
4) Dermal Contact with Soil

Subsurface Soil for Resident Child, Resident Adult and Commercial Worker

1) Indoor Inhalation of Vapor Emissions

Groundwater for Resident Child, Resident Adult and Commercial Worker

1) Indoor Inhalation of Vapor Emissions

Table 3.3 Tier 3A Analysis

Table 3.3A Outdoor Inhalation of Vapors and Particulates, Dermal Contact and Accidental Ingestion - Surficial Soil
Table 3.3B Outdoor Inhalation of Vapors and Particulates from Surfical Soil
Table 3.3C Ingestion of Surficial Soil
Table 3.3D Dermal Contact with Surficial Soil
Table 3.3E Indoor Inhalation of Vapor Emissions - Subsurface Soil
Table 3.3F Indoor Inhalation of Vapor Emissions - Groundwater

For each complete pathway and receptor described in Tables 3.1 and 3.2 include the following information on Tables 3.3A - 3.3F:

1) Completed Pathway
2) Current and/or Future Conditions
3) Receptor
4) Chemical of Concern
5) Representative Concentration (refer to section 5.4.2 of the KRBCA manual) (bold concentrations above the RBSL) for onsite and/or offsite conditions.
6) Tier 3A Risk-Based Screening Level

Table 3.3G Soil Leaching to Groundwater & Point of Compliance Concentrations

Include the following information:

1) Chemical of Concern

2) Representative Concentration of Soil at Source (refer to section 5.4.2 of the KRBCA manual) (bold concentrations above RBSL)
3) Tier 3A Risk-Based Screening Level for Soil at Source for Point of Exposure (POE)
4) Representative Concentration of Groundwater at Point of Compliance (POC)
5) Tier 3A Risk-Based Screening Level at POC
6) Distance to POE (provide justification)
7) Distance to POC (provide justification). If a different POC from the Tier 3A default is used it must be an actual sampling location located between the source area and the POE.

Table 3.4 Tier 3B Analysis

Table 3.4A Outdoor Inhalation of Vapors and Particulates, Dermal Contact and Accidental Ingestion
Table 3.4B Outdoor Inhalation of Vapors and Particulates from Surficial Soil
Table 3.4C Ingestion of Surficial Soil
Table 3.4D Dermal Contact with Surficial Soil
Table 3.4E Indoor Inhalation of Vapor Emissions - Subsurface Soil
Table 3.4F Indoor Inhalation of Vapor Emissions - Groundwater

For each complete pathway and receptor described in Tables 3.1 and 3.2 include the following information on Tables 3.4A - 3.4F:

1) Completed Pathway
2) Current and/or Future Conditions
3) Receptor
4) Chemical of Concern
5) Representative Concentration (refer to section 5.4.2 of the KRBCA manual) (bold concentrations above the RBSL) for onsite and/or offsite conditions.
6) Tier 3B Risk-Based Screening Level .

Table 3.4G Soil Leaching to Groundwater & Point of Compliance Concentrations

Include the following information:
1) Chemical of Concern
2) Representative Concentration of Soil at Source (refer to section 5.4.2 of the KRBCA manual) (bold concentrations above RBSL)
3) Tier 3A Risk-Based Screening Level for Soil at Source for Point of Exposure (POE)
4) Representative Concentration of Groundwater at Point of Compliance (POC)
5) Tier 3A Risk-Based Screening Level at POC
6) Distance to POE (provide justification)

7) Distance to POC (provide justification) If a different POC from the Tier 3A default is used it must be an actual sampling location located between the source area and the POE.

Section 4.0 Maps

All maps must be drawn to scale and labeled with the titles provided. Do not reference or include in this section any discussion, tables, photographs, drilling logs, or other documents included in this or any other report.

The scale for figures 3 through 5 and 7 should be approximately 1 inch ≤ 50 feet for smaller sites and 1 inch ≤ 100 feet for larger sites. The scale for figures 4, 5, and 7 may be adjusted to enlarge the area of the plume if the plume is small, provided that sufficient site features are shown to identify the area mapped. Maps should be 8.5" X 11" or 11" X 17" whenever possible. If warranted, the KDHE Project Manager should be contacted for approval to use a scale or figure size other than specified herein. Include a north arrow, scale, and legend on all maps. Legends should include only those items that occur at the site.

Figures 3 through 7 should include wells and borings, with ID numbers, and only those labels necessary to describe information requested for that specific map. Private and PWS wells should be designated consistently throughout the report.

Figure 1 General Site Location

A map adapted from a USGS 7.5 minute quadrangle, depicting the site location and a one mile radius of the site. Highlight or mark the location of the site. Contours and other information should be clear and legible.

Figure 2 Area Base Map

Two area base maps will be included in the report. The maps will be enlarged such that the facility is located at or near the center of the map. Figure 2.1 will depict the site and a minimum 350 foot radius around the source(s) of contamination. Figure 2.2 will depict the site and a minimum 500 foot radius around the source(s) of contamination or the complete area of the investigation, whichever is greater. Figure 2.1 will have an approximate scale of 1" = 100'. Figure 2.2 will have an approximate scale of 1" = 125'. Maps should be on 8 ½" x 11" or 11" x 17" paper. If groundwater is less than 20 feet BGS a door to door search for basements must be made within a 500 foot radius of the source of contamination.

The following should be included on both maps: 1) all groundwater probes, soil borings, and wells. 2) property boundaries and buildings 3) identify the general use (residential, park, undeveloped, industrial, commercial) of properties in this area. 4) business names 5) locations or former locations of all tanks, lines, buildings, roads and other fixed objects on the facility property 6) locations of all

underground utility trenches within 100 feet of the contaminant plume(s). State the type and depth of each utility service. 7) basements if door to door search is required.

If the Tier 3A default of 500' for the POE is not used include the location of the POE on Figure 2.2.

Figure 3 Groundwater Flow Map

Adapted from Figure 2. Label each well with the well ID, the elevation of each well (casing), static groundwater elevation, labeled equipotential contours encompassing all water measurement points, and arrow(s) indicating predominant flow paths and direction. Use all points measured for the investigation when contouring. Anomalous data points should be noted on the map. Show flow line used for calculating hydraulic gradient.

Figure 4 Soil Contamination Maps

Develop, down to laboratory non-detect (ND) levels, all soil contamination maps outlined below. Use Figure 2 as the template, and show the locations of all borings. The estimated areal extent of soil contamination above the capillary fringe must be outlined.

Use the highest soil laboratory analysis from above the capillary fringe in each boring for contouring purposes. Label sample points with depth for each sample collected for laboratory analyses from each boring. Isoconcentration lines should be labeled with the concentration in ppm. If the contaminant being mapped was detected in less than three sampling locations, submit a map showing the sample points labeled with the concentration in ppm but do not contour. If the constituent being mapped was not detected in any boring, omit map.

4.1 Benzene in Soils
4.2 Toluene in Soils
4.3 Ethylbenzene in Soils
4.4 Xylenes in Soils
4.5 TPH, OA-1 in Soils
4.6 TPH, OA-2 in Soils
4.7 1,2 DCA is Soils
4.8 Methyl Tertbutyl Ether (MtBE) in Soils
4.9 Naphthalene in Soils
4.10 Ethylene Dibromide (EDB) in Soils

Figure 5 Groundwater Isoconcentration Maps

Develop, down to non-detect (ND) levels, all Groundwater isoconcentration maps outlined below. Use Figure 2 as the template, and show all monitoring wells and sampling points, with ID numbers, sampled during the investigation. Label sample points and isoconcentration lines with the concentration in ppb. If the contaminant being mapped was detected in less than three sampling

locations, submit a map showing the sample points labeled with the concentration in ppb but do not contour. Sample points shall be labeled with concentration in ppb. If a constituent being mapped was not detected in any well, omit map.

5.1 Total BTEX in wells
5.2 Benzene in wells
5.3 Toluene in wells
5.4 Ethylbenzene in wells
5.5 Total Xylenes in wells
5.6 TPH OA-1 in wells
5.7 TPH OA-2 in wells
5.8 1,2 DCA in wells
5.9 MtBE in wells
5.10 Naphthalene in wells
5.11 EDB in wells

Figure 6 Groundwater Composite Historical Contamination Maps

This should be a historic combination of maps indicating snapshots of the following groundwater contaminant plumes.

Figure 6.1 Total BTEX
Figure 6.2 Benzene
Figure 6.3 MtBE

If the contaminant has not been historically detected in three or more wells, that specific combination of maps may be omitted from the report. In addition, if Naphthalene or EDB is found in concentrations above Tier 2 RBSL's during any historic sampling event and has been detected in three or more wells, composite historical contamination maps will be submitted for that contaminant.

These should be, at a minimum, 3" x 4" reductions of the isoconcentration maps similar to Figure 5 maps and placed on 11" x 17" paper. Each page should include a minimum of six reduced maps. Submit one page per constituent. The first map will be the initial concentrations or earliest concentrations available. The final map will be the analytical results obtained from this KRBCA scope of work. The maps between the initial map and final map will be the four most recent analytical results. The sampling data and date will be clearly labeled on each reduced map.

Figure 7 Separate Phase Product Isopach Map

Develop a product isopach map, using Figure 2 as the template, any time separate phase product is detected. Each map shall include the location of all monitoring wells or sampling points. If more than one product is identified, specify the products and their approximate percent of the total product phase.

Figure 8 Wells within ¼ Mile*

The map will be enlarged such that the facility is located at or near the center of the map. The map will have a scale of approximately 1" = 300' and be on an 11" x17" page. All wells will be clearly marked and labeled as to the current use (eg: industrial, public drinking supply, monitoring). If the contaminant plume is expected to extend beyond ¼ mile from the facility, the map (scale) will be modified to include all wells potentially impacted by the release. Well descriptions may appear on an attached table. Generalized groundwater flow direction will be clearly indicated.

Figure 9 Land Use within ¼ mile*

Map will clearly indicate current land uses within a ¼ mile radius of the facility. The map will have a scale of approximately 1" = 300' and be on an 11" x17" page. The facility will be at or near the center of the map. If the contaminant plume is expected to extend a distance greater than ¼ mile, the scale of the map will be changed to include the areas potentially affected. At a minimum, the maps must include either residential or non residential. If a sensitive receptor such as a subsurface structure, school or hospital is present within this area, that structure must be indicated on the map.

* Maps must be CAD drawings or other computer generated representations of the specified area. Locations and names of all major streets must be included on the map.

Section 5.0 Drilling Logs

Include schematics for each boring drilled and each monitoring well installed during the investigation. At a minimum, the following information must be included on each log:

1) the boring and monitoring well ID number,
2) the date the drilling was conducted,
3) the names of the Driller and Geologist,
4) the drilling method/type of drill rig, soil sampling equipment, and field screening analysis equipment used,
5) borehole and casing diameters,
6) field screening results plotted at the depth measured,
7) a continuous soil profile will be developed with detailed lithologic descriptions using the Unified Soil Classification System (USGS). The detailed lithological descriptions must correspond to the depths measured during drilling. The profile will also include the color, texture, sorting, size and shape of grains, and any other pertinent information,
8) observations such as fracturing or solution cavities, organic content, staining, odor, moisture changes (dry, moist, saturated), and any other pertinent features,
9) a monitoring well construction diagram that accurately depicts the depth of the screen, blank casing, filter pack, bentonite seal, grout seal, well-head completion, and

the surveyed elevations of the top of the casing and the permanent datum control point on the pad or flush mount rim, and

10) depth the saturated zone was encountered during drilling and elevation of static water level.

11) indicate where laboratory and hydrologic samples were collected, including interval.

The monitoring well construction diagram and the corresponding drilling log must be shown on the same page, and be drawn at the same vertical scale. Logs must be typed. Do not use abbreviations. Do not reference or include in this section any discussion, tables, photographs, maps, or other documents included in this or any other report.

Section 6.0 Photographs

6.1 All photographs shall be color print or color copies. Photographs should be taken from an appropriate distance and angle for the subject to be clearly visible and identifiable. Do not reference or include in this section any discussion, tables, drilling logs, maps, or other documents that are included in this report.

6.2 Each photograph shall illustrate the spatial relationships of the various components at the site.

6.3 Each photograph shall include a description of the scene, the direction the picture was taken from, and the date and time of the photo.

6.4 Include four photographs (two per page) of the entire facility from two distinctively different directions. Identify any current storage tank system components that appear in the photographs, whether or not they were a source of contamination, and any product recovery or remediation system components. Identify the location of any former tank basins and/or system components.

Section 7.0 Documentation

Include all information requested in the following format. Do not reference or include in this section any discussion, tables, photographs, maps, or other documents that are included in this report or any other report.

Appendix 1 Risk Assessment Worksheet

Include the completed cover sheet and Risk Assessment Worksheet provided in Attachment B Worksheet must be thoroughly completed. Explanation for missing information must be included on the worksheet. Incomplete worksheets will be justification for returning the final report without review as stated in the Petroleum Storage Tank Release Trust Fund Policy and Procedures Manual.

Worksheet must be completed by personnel that have a certificate on file with KDHE verifying the completion of a Risk Based Corrective Action (RBCA) training program conducted by an ASTM (American Society for Testing and Materials) certified trainer.

Appendix 2 Kansas Risk Based Corrective Action Software Output Sheets

Include the signed KRBCA Output Sheets Cover Sheet and copies of following pages of the KRBCA computer software output sheets. Titled divider pages should separate the following output sheets.

1) Receptor(s) and Route(s) of Exposure
2) Physical and Chemical Properties of Chemicals of Concern
3) Toxicological Properties of Chemicals of Concern
4) Exposure Factors
5) Fate and Transport Parameters for Tier 3A analysis
6) Fate and Transport Parameters for Tier 3B analysis
7) All four Risk-Based Screening Level pages for Tier 3A analysis
Groundwater Use - Without Biodegradation for Tier 3A analysis
8) All four Risk-Based Screening Level pages for Tier 3B analysis
Groundwater Use - Without Biodegradation
Groundwater Use - With Biodegradation (if biodegradation used)

KRBCA software version 5.0 or higher must be used. If any default values are changed in the computer program, justification for the change(s) must be provided. KRBCA computer software must be operated by personnel that have a certificate on file with KDHE verifying the completion of training in a RBCA program as stated in the requirements for Appendix 1. A cover sheet has been provided in Attachment C.

Appendix 3 Unsaturated Zone Hydrologic Data

Include all information and calculations to determine the unsaturated zone characteristics. If values are calculated by a computer program, include a copy of the computer output and state the program used.

Appendix 4 Saturated Zone Hydrologic Data

Include all raw data (laboratory test data, grain size distribution plots, etc.) and calculations used to determine the saturated zone hydrologic characteristics. Identify the variables and provide the calculated or assigned values. Include all information submitted by the laboratory on sheets provided by the laboratory.

Appendix 5 Laboratory Data

Include all analytical laboratory reports and Chain of Custody documents. All lab reports must include the following QA/QC data for all samples:

- Calibration check against the true value or initial calibration every 20 samples. This should be a mid-range calibration.
- Surrogate % recovery for each soil and water sample.
- Matrix spike and duplicate for each constituent every 20 samples or each run, whichever is more frequent.
- Method blank and duplicate for each extraction.
- Trip blank for each shipping container.

Reporting limits for all samples must be the Practical Quantitation Limit (PQL) for that sample. Reporting limits set at the MCL is not acceptable. Reports for all OA-2 analyses must also include copies of the reference standard chromatographs used. Include results of free product analyses (including laboratory chromatographs) if product samples were collected.

Appendix 6 Field Notes

Field notes must be hand-written and signed by the individual who performed the work described therein. Each page must be signed as the notes are being taken. Include copies of the following:

1) all drilling logs, soil sampling notes, and monitoring well completion notes,
2) groundwater sampling notes recording, for each well sampled, the water depth and total depth; the volume, in gallons, of water removed for well development and the volume, in gallons, of water purged before sampling; the name, address, and telephone number of the well owner and the site tenant if any private wells are sampled,
3) the Project Geologist's notes from the slug tests, and
4) any and all other field notes recorded during the investigation. Field notes must include the daily chronological events. This includes, time of day each boring/well was initiated, completed, sampled, static water level measured, triangulation calculations and all pertinent information relevant to the assessment. Field notes should not include a general summary of methods and procedures used during the assessment.

Appendix 7 Reports, Access Agreements, Lien Releases and Monitoring Well Information

Include copies of the following:

1) the RLS surveyor's report,
2) the KDHE BOW water well search report. and
3) all signed access agreements
4) copy of the site specific Bureau of Water waiver to install flush mount wells
5) copy of the wastewater disposal waiver letter from the Bureau of Water
6) all signed lien releases
7) include a copy of the completed KDHE Site Identification Form for each well installed or tagged.

8) include a copy of the KDHE Water Well Record (form WWC-5) for each monitoring well installed.
9) documentation of property record search used to complete Attachment B in Appendix 1.

Appendix 8 Off-Site Waste Handling Documentation

Provide documentation of how wastes removed from the site were handled and/or treated, including the authorization for wastewater disposal.

Electronic Data

The following information must be supplied on a compact disc (CD) after the final report has been approved. The CD will contain the following information:

1) The following portions of the final report must be submitted in any word processing document.

Cover Page
Table of Contents
Section 1.0, Site Summary, in Section 3.0 of the Final Report Format

2) The data included in Tables 2.1 through 2.7 and 3.1 through 3.4, must be submitted in Excel or Quattro Pro spreadsheet or in Microsoft Access Database format.

3) Figures 2 through 7 will be submitted in CAD files in a DXF interchange format (preferred) or as a JPG (Joint Photographic Experts Group format). The file must be named according to one of the following conventions. Site name, last five digits of project code followed by .dxf or . jpg. Example: ABCgasstation12375.dxf

ATTACHMENT A

FIELD WORK PLAN WORKSHEET

PETROLEUM STORAGE TANK RELEASE TRUST FUND
FIELD WORKPLAN WORKSHEET

Site Name: _____ KDHE Project Code: _____

Vendor: _____ Vendor Contact: _____

Instructions: This form ust be completed by providing the information requested below. Do not include any attachments with this worksheet other than those described herein.

I Site Information

Site Address: _____ (Street) _____ (City) Kansas _____ (County)

Legal Description: _____ 1/4 _____ 1/4 _____ 1/4 _____ 1/4 Section _____ Township _____ Range _____ E / W

II Investigation Information

Check the general methodologies to be used: _____ Groundwater survey ____ Soil Borings _____ Monitoring Wells

List the requested information where indicated:

A) Groundwater Survey:
Sample Extraction Equipment _____

Sample Analysis Equipment _____

Compounds for Analysis with Detection Limits (DL)

Benzene	DL=	_____	ppb	Other:	_____	DL=	_____ ppb
Toluene	DL=	_____	ppb		_____	DL=	_____ ppb
Ethylbenzene	DL=	_____	ppb		_____	DL=	_____ ppb
Xylenes	DL=	_____	ppb		_____	DL=	_____ ppb

B) Drilling: (list primary equipment under column "A", under column "B", list drilling equipment to be used if auger refusal is encountered)

		A	B
Drill Rig	Brand/Model	_____	_____
	Tourque Rating	_____	_____
Drill String	Type (Augers, etc)	_____	_____
	O.D. / I.D.	_____	_____
Borehole Size		_____	_____
Sample Collection Equip		_____	_____
Drilling Sample Frequency		_____	_____

C) Field Screening Instrument

Device (Brand / Type / Spec) _____

Calibration Standard _____

3) Hydrogeologic Testing Methods: (list methods and number of tests)

Unsaturated Zone _____ Number of tests _____

_____ Number of tests _____

_____ Number of tests _____

_____ Number of tests _____

Saturated Zone _____ Number of tests _____

4) Laboratory Analytical:

Soil Samples Collection Equipment _____

Analytical Methods _____

Water Samples Collection Equipment _____

Analytical Methods _____

Laboratory to Conduct Analysis _____

5) Waste Handling Procedures - Briefly describe how soil and water waste will be handled, treated, or disposed of:

Soil _____

Water _____

6) Decontamination - Briefly describe decontamination equipment, methods and procedures to be employed:

_____

_____

_____

III Site Maps, Photos and Site Conceptual Exposure Model

Note: All maps and photos must include a scale, north arrow and legend.

1) Attach a copy of a U.S.G.S. 7.5 minute quadrangle, scale 1:24,000, which depicts the general site location and the 1 mile radius area surrounding the site. The site must be highlighted or outlined for delineation.

2) Prepare and submit with this worksheet two site maps in accordance with and containing the following information:

A Scale such that 1 inch is less than or equal to 50 feet for smaller sites and 1 inch is less than or equal to 100 feet for larger sites.

B Site property boundaries, buildings or other fixed objects, and street names.

C One site map will depict the site including a minimum 350' radius from the release. The other site map will depict the site including a minimum 500' radius from the release. Both maps will include the general use of surrounding properties identified; i.e., residential, industrial, business (indicate what type - fast food, service stations, etc.). List owners names relative to off - site properties.

D Tanks, lines, and pump islands, currently or formerly located at the site.

E General locations and depths of all utilities on and adjacent to the site from visual survey of site.

F If a Geoprobe Survey is requested: Proposed probe locations for at least the "Groundwater Contamination" scope of work. Include existing wells within 350' from the source. All wells should be designated in accordance with previous reports if available.

G If a Geoprobe Survey is not requested: Proposed boring and monitoring well locations instead of proposed geoprobe points must be indicated.

H Accessible easements within the specified area.

I Arrow depicting groundwater flow direction.

Include the most recent aerial photograph available showing the site location and the specified area; the maximum scale of the aerial photograpgh shall be 1 inch = 250 feet. The aerial photo must be an original print, a high quality color copy of an original print, or a blueline. Prominent features (buildings, storage tanks, pump islands, existing wells, etc) should be denoted on the aerial photograph.

Include current photographs as stated in 4.2.1 under Section 4.0, Deliverables, in the LSA RFP.

3) Include site conceptual exposure models for current and future on site and off site conditions as described in Section 3.0 of the KRBCA Report Format.

IV Field Personnel / Health and Safety Plan

List below the consultant's personel and any subcontracting firms that will be involved in the investigation. Indicate each individual's name and position title (attach an additional sheet if necessary). If resumes documenting education, experience, and safety training certification have not been provided with the original bid package for all those listed, submit this information with this worksheet.

Name	Position Title	Name	Position Title

Indicate whether a Health and Safety Plan has been prepared for this investigation: Yes _____ No _____

ATTACHMENT B

RISK ASSESSMENT WORKSHEET

Kansas Department of Health & Environment

Storage Tank Program

Risk Assessment Worksheet

Project ID: _____ **Facility Name:** _____

Facility ID: _____ **Facility Address:** _____

_____

Completed By: **Signature:**

_____ _____

Signatory must have certificate on file with KDHE verifying the completion of a Risk Based Corrective Action (RBCA) Program conducted by an ASTM (American Society for Testing and Materials) certified trainer.

Kansas Department of Health & Environment Storage Tank Program
Risk Assessment Worksheet

Surface Condition: Improved ☐ Unimproved ☐

Has a drinking water well been impacted by a release at this site? ☐ yes ☐ no

What is the current land use of this facility / area? _____

SITE HISTORY: Guidance Document: Section 7.3.2 of ASTM Practice E1527-00. Standard Practice for Environmental Site Assessments: Phase 1 Environmental Site Assessment Process. Attach record search to end of this attachment.

List all previous names of this facility.	Owner Name	Dates Owned	Property Use C = Commercial I = Industiral R = Residential	Was Fuel Dispensed At the Facility Y = Yes, N= No U = Unknown

GEOLOGY / HYDROLOGIC CHARACTERISTICS

Stratigraphy: (Notate Start of Saturated Zone)

Depth	USCS Code	Description

Hydrologic Characteristics:

Static Water Level	_____	feet	As specified in RFP*
Flow Direction	_____		As specified in RFP*
Hydraulic Gradient	_____	(ft/ft)	As specified in RFP*
Estimated Porosity (unsaturated)	_____	(cm^3/cm^3)	As specified in RFP*
Gravimetric Water Content (unsaturated)	_____	(gm/gm)	Using ASTM Method D2216-98
Volumetric Water Content (unsaturated)	_____	(cm^3/cm^3)	Using ASTM Method D2216-98
Dry Bulk Density (unsaturated)	_____	(gm/cm^3)	Using ASTM Method D2937-00e1
Storativity	_____	1/ft	As specified in RFP*
Transmissivity	_____	(m^2/day)	As specified in RFP*
Hydraulic Conductivity (saturated)	_____	(cm/sec)	As specified in RFP*
Velocity	_____	(cm/sec)	As specified in RFP*
Annual Precipitation (30 yr avg)	_____	Inches/year	National Weather Service, KGS, Other
Organic Matter (unsaturated)	_____	% Organic Matter	If ASTM D2974-00 is used
Total Organic Carbon (unsaturated)	_____	% Organic Carbon	Walkley-Black Method/ASTM D2974-00

* Kansas Petroleum Storage Tank Release Trust Fund Limited Site Assessment Request for Proposal or Monitoring Request for Proposal. Available upon request.

Kansas Department of Health & Environment Storage Tank Program

Risk Assessment Worksheet

Is the water bearing zone capable of yielding greater than 10 GPH for a period of 24 hours? _____yes _____no _____unknown

Is the aquifer being used for human consumption within 500 feet of the contaminant plume? _____ yes _____no

Aquifer name if applicable _____

Identify any hydrogeologically sensitive areas that are threatened by the contaminant plume: _____

MAP

Land Use within 1/4 mile of facility

Indicate all wells within 1/4 mile radius of the facility. The map will be enlarged such that the facility is located at or near the center of the map with a scale of approximately 1 " = 300 " and be on an 11" x 17" page. All wells will be clearly marked and labelled as to current use (eg: industrial, public drinking supply). If the contaminant plume is expected to extend beyond 1/4 mile from the facility, the map (scale) will be modified to include all wells potentially impacted by the release. Well descriptions may appear on an attached table. Generalized groundwater flow direction will be clearly indicated. Map must be a CAD drawing or other computer generated representation of the specified area. Locations and names of all major streets must be included on the map.

RECEPTORS

Utilities:

	Depth (ft)	Flow Direction
Sanitary Sewer		
Storm Sewer		
Electric Cable		
Gas Line		
Fiber Optic		
Telephone		
Water		

Substance Released:

Gasoline	
Deisel	
Used Oil	
A V Gas	
Jet Fuel	
Hydraulic Fluid	
Other	

Subsurface Structures:

Indicate and describe all subsurface structures that are potential or current receptors of contaminated media.

Location	Description

Map

Land Use within 1/4 mile of facility

Attach a map that clearly indicates current land uses within a 1/4 mile radius of the facility. The map will have an approximate scale of 1 " = 300 ' and be on an 11" x 17" page. The facility will be at or near the center of the map. If the contaminant plume is expected to extend a distance greater than 1/4 mile, the scale of the map will be changed to include the areas potentially affected. At a minimum, the maps must indicate either residential or non-residential. If asensitive receptor such as a subsurface structure, school or hospital is present within this area, that structure must be indicated on the map. Map must be CAD drawings or other computer generated representations of the specified area. Locations and names of all major streets must be included on the map.

Kansas Department of Health & Environment Storage Tank Program
Risk Assessment Worksheet

Groundwater Supplies

Please indicate the presence of current water supplies within 1/4 mile of the facility:

Well Owner Name	Address	Water Supply Type				Source Type	
		Public	Domestic	Lawn	Other	Well	Surface

Have any surface waters been impacted by a release from this facility? _____yes _____no

If yes describe the impact: _____

Describe any potential threats to other sensitive receptors within 1/4 mile from this facility: _____

Is Public water currently being supplied to the area? _____yes _____no

If no, would future development around this facility be likely? _____yes _____no

Are there any nuisance conditions at the site? _____yes _____no

If Yes, describe below

Kansas Department of Health & Environment Storage Tank Program
Risk Assessment Worksheet

EXPOSURE PATHWAYS

Indicate by placing an X in any of the pathways that are complete.

Current On-Site

Exposure Route	Resident Adult	Resident Child	Construction Worker	Commercial Worker
Ingestion				
Inhalation				
Dermal				

Please describe any complete pathways and justify incomplete pathways.

Current Off-Site

Exposure Route	Resident Adult	Resident Child	Construction Worker	Commercial Worker
Ingestion				
Inhalation				
Dermal				

Please describe any complete pathways and justify incomplete pathways.

Preparer should attatch additional sheets if necessary

Notes:

Kansas Department of Health & Environment Storage Tank Program
Risk Assessment Worksheet

Exposure Pathways (contd)

Indicate by placing an X in any of the pathways that are complete. Any complete pathways must be justified.

Potential Future On-Site

Exposure Route	Resident Adult	Resident Child	Construction Worker	Commercial Worker
Ingestion				
Inhalation				
Dermal				

Please describe any complete pathways and justify incomplete pathways.

Potential Future Off-Site

Exposure Route	Resident Adult	Resident Child	Construction Worker	Commercial Worker
Ingestion				
Inhalation				
Dermal				

Please describe any complete pathways and justify incomplete pathways.

Preparer should attatch additional sheets if necessary

Notes:

ATTACHMENT C

KRBCA OUTPUT SHEETS COVER SHEET

ATTACHMENT C

Kansas Department of Health and Environment

Storage Tank Program

KRBCA Output Sheets

KDHE Project Code: _____ Facility Name:_____

Facility I.D.: _____ Facility Address:_____

_____

Output Sheets Completed By:

_____

Signature:

_____

Date:

_____

Signature must have certificate on file with KDHE verifying the completion of a Risked Based Corrective Action (RBCA) program conducted by an ASTM (American Society of Testing and Materials) certified trainer.

ATTACHMENT D

SITE CONCEPTUAL EXPOSURE MODELS

SITE CONCEPTUAL EXPOSURE MODEL - Current Conditions

Current On-Site		**Surficial Soil**				**Subsurface Soils**	**Groundwater**	
Receptor		Outdoor Inhalation of Vapors & Particulates, Dermal Contact, & Accidental Ingestion	Outdoor Inhalation of Vapors & Particulates	Ingestion of Soil	Dermal Contact with Soil	Indoor Inhalation of Vapor Emissions	Indoor Inhalation of Vapor Emissions	Justification
Resident Child								
Resident Adult								
Commercial Worker								
Construction Worker						**NA**	**NA**	

Current Off-Site		**Surficial Soil**				**Subsurface Soils**	**Groundwater**	
Receptor		Outdoor Inhalation of Vapors & Particulates, Dermal Contact, & Accidental Ingestion	Outdoor Inhalation of Vapors & Particulates	Ingestion of Soil	Dermal Contact with Soil	Indoor Inhalation of Vapor Emissions	Indoor Inhalation of Vapor Emissions	Justification
Resident Child								
Resident Adult								
Commercial Worker								
Construction Worker						**NA**	**NA**	

Place a mark in the box if the exposure pathway is complete for each Receptor, and provide justification.
Surficial soils = 0-1' for Residents, and the Commercial Worker.
Surficial soils = 0-10' for the Construction Worker.
Groundwater Resource Protection Pathway is always complete.
Add footnotes if applicable.

SITE CONCEPTUAL EXPOSURE MODEL - Future Conditions

Future On-Site	**Surficial Soil**				**Subsurface Soils**	**Groundwater**	
Receptor	Outdoor Inhalation of Vapors & Particulates, Dermal Contact, & Accidental Ingestion	Outdoor Inhalation of Vapors & Particulates	Ingestion of Soil	Dermal Contact with Soil	Indoor Inhalation of Vapor Emissions	Indoor Inhalation of Vapor Emissions	Justification
Resident Child							
Resident Adult							
Commercial Worker							
Construction Worker					**NA**	**NA**	

Future Off-Site	**Surficial Soil**				**Subsurface Soils**	**Groundwater**	
Receptor	Outdoor Inhalation of Vapors & Particulates, Dermal Contact, & Accidental Ingestion	Outdoor Inhalation of Vapors & Particulates	Ingestion of Soil	Dermal Contact with Soil	Indoor Inhalation of Vapor Emissions	Indoor Inhalation of Vapor Emissions	Justification
Resident Child							
Resident Adult							
Commercial Worker							
Construction Worker					**NA**	**NA**	

Place a mark in the box if the exposure pathway is complete for each Receptor, and provide justification.
Surficial soils = 0-1' for Residents, and the Commercial Worker.
Surficial soils = 0-10' for the Construction Worker.
Groundwater Resource Protection Pathway is always complete.
Add footnotes if applicable.

ATTACHMENT E

TABLES 3.3 AND 3.4 FORMATS

Tables 3.3 and 3.4 samples

Recommended format for the following tables:
3.3A and 3.4A Outdoor Inhalation of Vapors and Particulates, Dermal Contact and Accidental Ingestion - Surficial Soil
3.3B and 3.4B Outdoor Inhalation of Vapors and Particulates from Surficial Soil
3.3C and 3.4C Ingestion of Surficial Soil
3.3D and 3.4D Dermal Contact with Surficial Soil
Include the **Receptors**, and the applicable current and/or future **Conditions** in the table.
All soil contamination concentrations will be stated in units of mg/kg (ppm).

Conditions	Current / Future		Current / Future		Current / Future		Current / Future	
Receptors	**Resident Child**		**Resident Adult**		**Commercial Worker**		**Construction Worker**	
Chemicals of Concern	On-site Rep. Conc.	Tier 3A or 3B RBSL's	On-site Rep. Conc.	Tier 3A or 3B RBSL's	On-site Rep. Conc.	Tier 3A or 3B RBSL's	On-site Rep. Conc.	Tier 3A or 3B RBSL's
Benzene								
Toluene								
Ethylbenzene								
Xylenes								
1,2 DCA								
MtBE								
Naphthalene								
EDB (Ethylene Dibromide)								

Rep. Conc. = The Representative Concentration Surficial Soils contamination (0-10' for the Construction Worker, 0-1' for all others).
Do not include the receptor(s), representative concentration(s) or RBSL's for incomplete pathways.
In many situations, the 'soil source' area will be on-site, and the Rep. Conc. will be calculated for on-site conditions.
In the event the 'soil source' area extends off-site, the Rep. Conc. should also be calculated for off-site conditions.
In this situation, include an additional column for "Off-site Rep. Conc." when applicable.

Include appropriate Footnotes and Reference Table(s)

Tables 3.3 and 3.4 samples

Recommended format for the following table:

3.3E and 3.4E Indoor Inhalation of Vapor Emissions - Subsurface Soil

Include the **Receptors**, and the applicable current and/or future **Conditions** in the table.
All soil contamination concentrations will be stated in units of mg/kg (ppm).

Conditions	Current / Future		Current / Future		Current / Future	
Receptors	**Resident Child**		**Resident Adult**		**Commercial Wrkr**	
Chemicals of Concern	Onsite Rep. Conc.	Tier 3A or 3B RBSL's	Onsite Rep. Conc.	Tier 3A or 3B RBSL's	Onsite Rep. Conc.	Tier 3A or 3B RBSL's
Benzene						
Toluene						
Ethylbenzene						
Xylenes						
1,2 DCA						
MtBE						
Naphthalene						
EDB (Ethylene Dibromide)						

Rep. Conc. = The Representative Concentration of contamination in the Subsurface Soil (Vadose Zone)
Do not include the receptor(s), their representative concentration(s) or RBSL's for incomplete pathways.
In many situations, the 'soil source' area will be on-site, and the Rep. Conc. will be calculated for on-site conditions.
In the event the 'soil source' area extends off-site, the Rep. Conc. should also be calculated for off-site conditions.
In this situation, include an additional column for "Off-site Rep. Conc." where applicable.
Include appropriate Footnotes and Reference Table

Tables 3.3 and 3.4 samples

Recommended format for the following table:
3.3F and 3.4F Indoor Inhalation of Vapor Emissions - Groundwater
Include the **Receptors**, and the applicable current and/or future **Conditions** in the table.
All groundwater contamination concentrations will be stated in units of ug/l (ppb).

Conditions	Current / Future			Current / Future			Current / Future		
Receptors	**Resident Child**			**Resident Adult**			**Commercial Wrkr**		
Chemicals of Concern	Onsite Rep. Conc.	Offsite Rep. Conc.	Tier 3A or 3B RBSL's	Onsite Rep. Conc.	Offsite Rep. Conc.	Tier 3A or 3B RBSL's	Onsite Rep. Conc.	Offsite Rep. Conc.	Tier 3A or 3B RBSL's
Benzene									
Toluene									
Ethylbenzene									
Xylenes									
1,2 DCA									
MtBE									
Naphthalene									
EDB (Ethylene Dibromide)									

Rep. Conc. = The Representative Concentration of contamination in the groundwater.
Groundwater Representative Concentrations should be determined using per well per constituent values.
Do not include the receptor(s), their representative concentration(s) or RBSL's for incomplete pathways.

Include appropriate Footnotes and Reference Table (indicating the Rep. Conc. calculations).

Tables 3.3 and 3.4 samples

Recommended format for the following table:
3.3G and 3.4G Soil Leaching to Groundwater & Point of Compliance Concentrations

	Point of Exposure		Point of Compliance	
Chemicals of Concern	Representative Concentration of Soil at Source	Tier 3A or 3B RBSL's	Representative Concentration of GW at POC	Tier 3A or 3B RBSL's
Benzene				
Toluene				
Ethylbenzene				
Xylenes				
1,2 DCA				
MtBE				
Naphthalene				
EDB (Ethylene Dibromide)				

Distance to POE (in feet) =
Justification: state the reason for determining the location of the POE.
Distance to POC (in feet) =
Justification: state which fixed sampling point is used as the POC and why.

Use the appropriate units for soil (ppm) and groundwater (ppb) concentrations.
Include appropriate Footnotes and Reference Table(s)

ATTACHMENT F

TABLES 3.3 AND 3.4 REFERENCE TABLE FORMATS

Sample Reference Table - Surficial Soil (For Use with Tables 3.3 and 3.4A,B,C & D)

Soil lab data will be used to determine the Representative Concentration of each constituent at the site.
All soil contamination concentrations will be stated in units of mg/kg (ppm).

SURFICIAL SOIL REFERENCE TABLE
for Resident (Adult & Child) and Commercial Worker Receptors (0-1')

Boring # & Depth of Sample	Date Collected	Chemicals of Concern							
		Benzene	Toluene	Ethyl-benzene	Xylenes	1,2 DCA	MtBE	Naph-thalene	EDB
SB-1 (0-1')	10/17/02	8	20	65	240	ND	ND	ND	ND
SB-2 (0-1')	10/17/02	5	40	35	110	ND	ND	12	ND
SB-3 (0-1')	10/17/02	ND	ND	ND	ND	ND	ND	ND	ND
SB-4 (0-1')	10/17/02	0.75	20	19	200	ND	ND	ND	ND
SB-5 (0-1')	10/17/02	ND	ND	ND	ND	ND	ND	ND	ND
Highest concentration per constituent		8	40	65	240	ND	ND	12	ND
25% of highest concentration		2	10	16.3	60	NA	NA	3	NA
Total of conc. which are >25% of max. concentration		13	80	119	550	ND	ND	12	ND
Number of values used		2	3	3	3	-	-	1	-
Representative Concentration		**6.5**	**26.7**	**39.7**	**183.3**	**ND**	**ND**	**12**	**ND**

SURFICIAL SOIL REFERENCE TABLE for Construction Worker Receptor (0-10')

Boring # & Depth of Sample	Date Collected	Chemicals of Concern							
		Benzene	Toluene	Ethyl-benzene	Xylenes	1,2 DCA	MtBE	Naph-thalene	EDB
SB-1 (0-1')	10/17/02	8	20	65	240	ND	ND	ND	ND
SB-1 (5-10')	10/17/02	0.1	30	80	325	ND	ND	ND	ND
SB-2 (0-1')	10/17/02	5	40	35	110	ND	ND	12	ND
SB-2 (5-10')	10/17/02	0.06	60	60	155	ND	ND	28	ND
SB-3 (0-1')	10/17/02	ND	ND	ND	ND	ND	ND	ND	ND
SB-3 (5-10')	10/17/02	ND	ND	20	326	ND	ND	30	ND
SB-4 (0-1')	10/17/02	0.75	20	19	200	ND	ND	ND	ND
SB-4 (5-10)	10/17/02	0.09	12	11	140	ND	ND	25	ND
SB-5 (0-1')	10/17/02	ND	ND	ND	ND	ND	ND	ND	ND
SB-5 (5-10')	10/17/02	ND	ND	ND	ND	ND	ND	ND	ND
Highest concentration per constituent		8	60	80	326	ND	ND	30	ND
25% of highest concentration		2	15	20	81.5	NA	NA	7.5	NA
Total of conc. which are >25% of max. concentration		13	170	260	1496	ND	ND	95	ND
Number of values used		2	5	5	7	-	-	4	-
Representative Concentration		**6.5**	**34**	**52**	**213.7**	**ND**	**ND**	**23.8**	**ND**

Highlight or designate the values used in calculating the Representative Concentrations.
Representative Concentration will be calculated using the values per constituent equal to or greater than the 25% value.
These Reference Tables are used to define the Rep. Concentration of Surficial Soils used in Tables 3.3A-D & 3.4A-D.
ND = Lab Results indicate "ND"
NA = Not Applicable to this table

Sample Reference Table - Subsurface Soil (For Use with Tables 3.3 and 3.4E)

Soil lab data will be used to determine the Representative Concentration of each constituent at the site.
All soil contamination concentrations will be stated in units of mg/kg (ppm).

SUBSURFACE SOIL REFERENCE TABLE

Boring # & Depth of Sample	Date Collected	Chemicals of Concern							
		Benzene	Toluene	Ethyl-benzene	Xylenes	1,2 DCA	MtBE	Naph-thalene	EDB
SB-1 (5-10')	10/17/02	0.1	30	80	325	ND	ND	ND	ND
SB-2 (5-10')	10/17/02	0.06	60	60	155	ND	ND	28	ND
SB-3 (5-10')	10/17/02	ND	ND	20	326	ND	ND	30	ND
SB-4 (5-10)	10/17/02	0.09	12	11	140	ND	ND	25	ND
SB-5 (5-10')	10/17/02	ND	ND	ND	ND	ND	ND	ND	ND
Highest concentration per constituent		0.1	60	80	326	ND	ND	30	ND
25% of highest concentration		0.025	15	20	81.5	NA	NA	7.5	NA
Total of conc. which are >25% of max. concentration		0.25	90	160	946	ND	ND	83	ND
Number of values used		3	2	3	4	-	-	3	-
Representative Concentration		**0.083**	**45**	**53.3**	**236.5**	**ND**	**ND**	**27.7**	**ND**

Highlight or designate the values used in calculating the Representative Concentration.
Representative Concentration will be calculated using the values per constituent equal to or greater than the 25% value.
This Reference Table is used to define the Rep. Concentration of Subsurface Soils used in Table 3.3E and 3.4E.
At this site the swl is at 12 feet, therefore, no soil samples were collected at or below that level.
ND = Lab Results indicate "ND"
NA = Not Applicable to this table

Sample Reference Table - Soil Leaching to Groundwater (For Use with Tables 3.3 and 3.4G)

All soil contamination concentrations will be stated in units of mg/kg (ppm).

"SOIL AT SOURCE" Reference Table

Boring # & Depth of Sample	Date Collected	Chemicals of Concern							
		Benzene	Toluene	Ethyl-benzene	Xylenes	1,2 DCA	MtBE	Naph-thalene	EDB
SB-1 (0-1')	10/17/02	8	20	65	240	ND	ND	ND	ND
SB-1 (5-10')	10/17/02	0.1	30	80	325	ND	ND	ND	ND
SB-2 (0-1')	10/17/02	5	40	35	110	ND	ND	12	ND
SB-2 (5-10')	10/17/02	0.06	60	60	155	ND	ND	28	ND
SB-3 (0-1')	10/17/02	ND	ND	ND	ND	ND	ND	ND	ND
SB-3 (5-10')	10/17/02	ND	ND	20	326	ND	ND	30	ND
SB-4 (0-1')	10/17/02	0.75	20	19	200	ND	ND	ND	ND
SB-4 (5-10)	10/17/02	0.09	12	11	140	ND	ND	25	ND
SB-5 (0-1')	10/17/02	ND	ND	ND	ND	ND	ND	ND	ND
SB-5 (5-10')	10/17/02	ND	ND	ND	ND	ND	ND	ND	ND
Highest concentration per constituent		8	60	80	326	ND	ND	30	ND
25% of highest concentration		2	15	20	81.5	NA	NA	7.5	NA
Total of conc. which are >25% of max. concentration		13	170	260	1496	ND	ND	95	ND
Number of values used		2	5	5	7	-	-	4	-
Representative Concentration		**6.5**	**34**	**52**	**213.7**	**ND**	**ND**	**23.8**	**ND**

This Reference Table is used to define the Rep. Concentration of Soil at Source used in Table 3.3G and 3.4G.
Contamination detected in the soils will be used to determine the Rep. Conc. of Soil at Source, irregardless of depth.
Representative Concentration will be calculated using the values per constituent equal to or greater than the 25% value.

Reference Table for Groundwater Representative Concentrations

(For Use with Tables 3.3 and 3.4G)

All groundwater contamination concentrations will be stated in units of ug/l = ppb.

Data collected within the most recent 24 months from the KRBCA sampling date will be used to calculate the representative concentration. Values not used in calculating rep. conc. have been struck-out.
Highlighted values are greater than the 25% of the highest concentration per constituent per well, and are used to calculate the representative concentrations.

Monitoring Well #	Date Sampled	Chemicals of Concern (values stated in ppb)							
		Benzene	**Toluene**	**Ethylbenzene**	**Xylenes**	**1,2 DCA**	**MtBE**	**Naphthalene**	**EDB**
MW-1	08-10-01	~~330~~	~~680~~	~~5610~~	~~8800~~	~~ND~~	~~ND~~	~~172~~	~~ND~~
	11-12-01	276	630	5050	8536	ND	ND	36	ND
	02-09-02	400	490	3876	7856	ND	ND	45	ND
	05-15-02	68	255	330	680	ND	ND	15	ND
	08-08-02	374	415	2800	5544	ND	ND	22	ND
	11-10-02	326	351	1264	2965	ND	ND	12	ND
	02-12-03	282	300	652	2837	ND	ND	12	ND
	05-09-03	200	182	387	1625	ND	ND	ND	ND
	10-21-03	180	110	380	1432	ND	ND	ND	ND
Highest concentration per constituent		400	630	5050	8536	ND	ND	45	ND
25% of highest conc.		100	157.5	1262.5	2134	NA	NA	11.25	NA
Total of conc. which are >25% of max. conc.		2038	2623	12990	27738	ND	ND	142	ND
Number of values used		7	7	4	5	-	-	6	-
Representative Conc.		**291.1**	**374.7**	**3247.5**	**5547.6**	**ND**	**ND**	**23.7**	**ND**

MW-2	08-10-01	~~40~~	~~104~~	~~45~~	~~1560~~	~~ND~~	~~ND~~	~~ND~~	~~ND~~
	11-12-01	25	72	182	197	ND	ND	ND	ND
	02-09-02	6	13	453	149	ND	ND	ND	ND
	05-15-02	ND	20	62	ND	ND	ND	ND	ND
	08-08-02	ND	28	35	68	ND	ND	ND	ND
	11-10-02	ND	16	17	32	ND	ND	ND	ND
	02-12-03	ND	12	6	ND	ND	ND	ND	ND
	05-09-03	ND	3	ND	ND	ND	ND	ND	ND
	10-21-03	ND	ND	ND	ND	ND	ND	ND	ND
Highest concentration per constituent		25	72	453	197	ND	ND	ND	ND
25% of highest conc.		6.25	18	113.25	49.25	NA	NA	NA	NA
Total of conc. which are >25% of max. conc.		25	120	635	414	ND	ND	ND	ND
Number of values used		1	3	2	3	-	-	-	-
Representative Conc.		**25**	**40**	**317.5**	**138**	**ND**	**ND**	**ND**	**ND**

continued...

Monitoring Well #	Date Sampled	Chemicals of Concern (values stated in ppb)							
		Benzene	**Toluene**	**Ethylbenzene**	**Xylenes**	**1,2 DCA**	**MtBE**	**Naphthalene**	**EDB**
MW-3	08-10-01	~~ND~~	~~ND~~	~~ND~~	~~20~~	~~ND~~	~~ND~~	~~ND~~	~~ND~~
	11-12-01	ND	ND	ND	ND	ND	ND	ND	ND
	02-09-02	ND	ND	ND	ND	ND	ND	ND	ND
	05-15-02	ND	ND	ND	ND	ND	ND	ND	ND
	08-08-02	ND	ND	ND	ND	ND	ND	ND	ND
	11-10-02	ND	ND	ND	ND	ND	ND	ND	ND
	02-12-03	ND	ND	ND	ND	ND	ND	ND	ND
	05-09-03	ND	ND	ND	ND	ND	ND	ND	ND
	10-21-03	ND	ND	ND	ND	ND	ND	ND	ND
Highest concentration per constituent		ND	ND	ND	ND	ND	ND	ND	ND
25% of highest conc.		NA	NA	NA	NA	NA	NA	NA	NA
Total of conc. which are >25% of max. conc.		ND	ND	ND	ND	ND	ND	ND	ND
Number of values used		-	-	-	-	-	-	-	-
Representative Conc.		**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**	**ND**
MW-4	08-10-01	~~20~~	~~35~~	~~197~~	~~483~~	~~ND~~	~~ND~~	~~87~~	~~ND~~
	11-12-01	18	20	66	358	ND	ND	12	ND
	02-09-02	10	18	58	306	ND	ND	ND	ND
	05-15-02	5	10	27	187	ND	ND	10	ND
	08-08-02	3	ND	39	210	ND	ND	ND	ND
	11-10-02	ND	ND	12	165	ND	ND	ND	ND
	02-12-03	ND	ND	12	89	ND	ND	ND	ND
	05-09-03	ND	ND	ND	79	ND	ND	ND	ND
	10-21-03	ND	ND	ND	55	ND	ND	ND	ND
Highest concentration per constituent		18	20	66	358	ND	ND	12	ND
25% of highest conc.		4.5	5	16.5	89.5	NA	NA	3	NA
Total of conc. which are >25% of max. conc.		33	48	190	1226	ND	ND	22	ND
Number of values used		3	3	4	5	-	-	2	-
Representative Conc.		**11**	**16**	**47.5**	**245.2**	**ND**	**ND**	**11**	**ND**

NOTE: In this example, the analyses from only 4 monitoring wells are demonstrated for the sake of space! In actual reports, all data from all wells should be presented in this Reference Table.

Scenario for this site:

* The site is currently an active gas station.
* MW-1 is located 4 feet from the north side of the commercial building on-site.
* MW-3 is located 2 feet from the south side of the same commercial building.
* No other wells are located near the commercial building.
* Groundwater flow is to the South.

Evaluation of indoor air inhalation pathway via groundwater:

(For Use with Tables 3.3 and 3.4F)

1) Determine the representative concentration of groundwater contamination beneath the on-site commercial building by calculating an average of the representative concentrations for each constituent from MW-1 and MW-3:

		On-Site Representative Concentrations of Chemicals of Concern							
MW #		**Benzene**	**Toluene**	**Ethylbenzene**	**Xylenes**	**1,2 DCA**	**MtBE**	**Naphthalene**	**EDB**
MW-1		291	375	3248	5548	ND	ND	24	ND
MW-3		ND	ND	ND	ND	ND	ND	ND	ND
Average		**146**	**188**	**1624**	**2774**	**ND**	**ND**	**12**	**ND**

(Note: In this table, "ND" values = zero for calculation purposes.)
The "Average" is used as the Representative Concentration value in Tables 3.3F and 3.4F.
If the calculated "Average" does not adequately represent site specific conditions, proceed to the next step.

2) Use your "Best Professional Judgement" by presenting a value which adequately characterizes the contamination level of each constituent beneath the building. Provide your values and reasons for presenting these values. This judgement should be based on lithology, groundwater flow direction, stability of plume, mapped isocontours, and other site specific conditions (excavations, etc.).

3) Repeat the necessary steps for off-site conditions and provide justification as needed.

The Kansas Risk-Based Corrective Action process:

KDHE expects the consultant to use, initially, the highest contaminant concentrations to determine the Representative Concentrations. It is KDHE's intent to provide the most conservative 'risk assessment' for each site. In the event the selected Representative Concentrations exceed Tier 3B RBSL's, then the consultant should use their "Best Professional Judgement" to determine a reasonable Representative Concentration, if applicable. Each site has its own idiosyncrasies and each characteristic should be scrutinized during the KRBCA process.